SJI 2020 Y3OP PHYSICS EOY EXAM MARKING SCHEME

Paper 1

1	**B**	11	**C**	21	**B**
2	**D**	12	**C**	22	**B**
3	**B**	13	**B**	23	**B**
4	**A**	14	**D**	24	**D**
5	**A**	15	**D**	25	**A**
6	**B**	16	**A**	26	**B**
7	**B**	17	**B**	27	**C**
8	**A**	18	**A**	28	**B**
9	**B**	19	**D**	29	**A**
10	**B**	20	**D**	30	**B**

Paper 2

Section A

1	a.	t_{100} = 3.00 mm + 0.37 mm = 3.37 mm t = 3.37 / 100 x 10^{-3} m = **<u>3.37 x 10^{-5} m</u>**
	bi.	thickness= 0.22 mm = 0.00022 m volume = 0.00022 m x 0.594 m x 0.841 m = 0.0001099019 m^3 = **<u>0.00011 or 0.000110 m^3</u>**
	bii.	Mass of A1 cardboard = 400g x (0.594 m x 0.841 m) = 200 g ρ = mass / volume = 0.200 g / 0.00011 m^3 = **<u>1820 kg/m^3 or 1800 kg/m^3</u>**

2	a.	a = v-u/t = (30-10)/(3.0-1.0) = **<u>10 m/s^2</u>**
	b.	From **<u>3.0s to 4.0s</u>** : Velocity is **<u>decreasing at a constant rate/ uniform/constant deceleration</u>** and the jumper comes to rest momentarily at 4.0 s. From **<u>4.0s to 5.0s</u>**: Velocity is **<u>increasing at a constant rate/uniform/constant acceleration</u>** as the jumper moves up/rebound upward.
	ci.	Displacement = (½ x 30 x 4) – (1/2 x 2 x 8) = **<u>52 m</u>**
	cii.	Average speed = (½ x 30 x 4 +1/2 x 2 x 8) / 6.0 s =**<u>11.3 or 11 m/s</u>**

		ecf applies
	ciii.	The **distance** travelled by the jumper is **greater than his displacement** as it does not take into account the direction of motion of the jumper (as such average speed is greater than the average velocity)

3	a.	gas P = pgh = 13 600 x 10 x 0.40 = **54 400 or 54 000 Pa**
	b.	Cabin air pressure = 40 + 20 = **60 cm Hg**
	c.	h_1 drops while h_2 increases/the difference between h_1 and h_2 decreases. This is because the difference between the gas pressure and the cabin air pressure decreases. Or As the cabin air pressure increases and the gas pressure remains constant. The pressure on the left limb becomes higher than the right limb, creating a net force which pushes the mercury (down on the left limb and up on the right limb).
	di.	At high altitude the height of the layer of atmosphere above the aircraft is smaller / at high altitude the density of air is lower/the gravitaional field strength is lower. accept: KMT answer less particles per unit volume/lower temperature→ less frequency/force of collisions → less force/unit area→ less pressure
	dii.	P = F x A = 80 000 Pa x 0.0875 m^2 = **7000 N** [-1M] for wrong conversion of area from cm^2 to m^2

4	a.	**Loss in GPE** is equal to the **gain in KE** of toy car and **gain in** thermal energy of the toy car and surroundings due to **work done against friction**. The **sum** of the mechanical energy and thermal energy is always **constant**.
	bi.	1.0 kg x 10 N/kg x 0.30m = **3.0 J**
	bii.	Loss in GPE = gain in KE + work done against friction 3.0 J = 0.50(1.0kg)(2.5m/s)^2 – 0.50(1.0kg)(u^2) + 0.11N(0.90m)

		u = **<u>0.67 m/s</u>**
	c	The height and frictional force remain unchanged, hence the change in KE is unchanged. Doubling the initial speed would not double the final speed.

5	a.	Air particles move in continuous and random direction. The air particles constantly collide with the wall of the container and since there is area of contact, pressure is exerted on the wall.
	b.	Temperature drops and the average KE decreases. Frequency and force of collision with the wall decreases. Internal P decreases and is lesser than the external water+atm pressure. As such net force acting inward. or The vaporised water particles condenses and the number of air particles per unit volume in the can will decrease. Frequency of collision with the wall decreases. Internal P decreases and is lesser than the external water+atm pressure. As such net force acting inward.

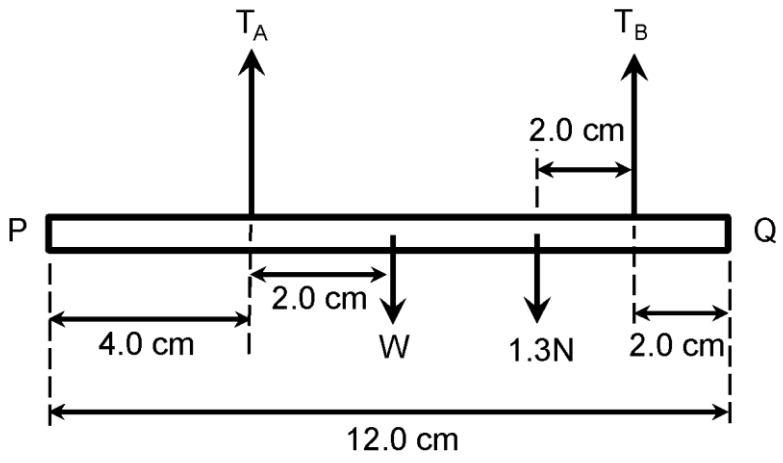
6	ai.	**<u>Vibration and collision</u>** of particles Free **<u>electron diffusion</u>**
	aii.	Cooler **<u>denser</u>** water **<u>sinks</u>**, warmer water below rises, set up **<u>convection currents</u>** result in mixing.

7	a.	It is a physical property that changes linearly and continuously with temperature over a range of temperature.
	b.	$\theta = \frac{30kPa - 10kPa}{90kPa - 10kPa} \times 100℃$ $= 25℃$

8	Light travels in straight line **<u>from lamp to A and P</u>**. Light **<u>reflecting off mirror</u>** is also incident **<u>on P but not A</u>** as the length of the mirror is not sufficient for light to reflect to A.

Section B

9	ai.	Fr = ma 800 N – f = (1200kg) x (0.50 m/s^2) f = **<u>200 N</u>**
	aii.	The velocity increases and the air resistance increases. The resultant force decreases, resulting in the acceleration decrease.
	bi.	1500 N (or tension) as the tension on the boat is the equal and opposite to the tension on the man.
	bii.	Correct shape correct arrows **<u>2200 ± 250 N</u>**
	biii.	Fr = ma 1500 N = (100 kg)(a) a = **<u>15 m/s^2</u>** Directly is **<u>opposite to the tension</u>** of the rope on the man

10	ai.	The centre of gravity of a body is **<u>a point</u>** through which its **<u>whole weight</u>** appears to act for any orientation of the body.
	aii	The cardboard will rest when its **<u>centre of gravity</u>** is **<u>vertically below the pivot P</u>**. At this position, (there is no perpendicular distance between its weight and the pivot point) the cardboard is **<u>not having any moment</u>** about the pivot.
	bi	

	bii	At equilibrium, the sum of clockwise moments about A = sum of anti-clockwise moments about A (W x 2.0 cm) + (1.3 N x 4.0 cm) = 1.0 N x 6.0 cm 2.0W + 5.2 Ncm = 6.0 Ncm 2.0W = 0.80 Ncm W = **0.40 N**
	biii	Mass of rod = 0.40 N / 10 N/kg = **0.040 kg**
	biv.	Sum of forces acting up = Sum of forces acting down $T_A + T_B$ = 0.40 N + 1.3 N (accept ecf of W from 2bii.) T_A = 0.40 N + 1.3 N – 1.0 N T_A = **0.70 N**
	bv.	M has to move **to the left**. So that the sum of **clockwise moments of M** about A is **reduced**, and hence **tension B** can also be **reduced** to equalize tension A.

11	ai.	Ratio of speed of light in vacuum to speed of light in glass is 1.6
	aii.	32.8^o
	aiii. 1	38.7^o
	aiii. 2	Angle of incidence >critical angle hence TIR occurs.
	aiii. 3	TIR and emerge at 60^o to normal
	aiv.	r increases. Light slows down less when travelling from water to glass as the ratio of the refractive indices decreases.
	bi	Due to the curved surface of the lens, light rays incident near the edges have a **larger angle of incidence** hence the light rays would refract by a larger angle.
	bii 1	Image height twice object height, arrows
	bii 2	v = 36 cm